CEREAL SCIENCE today

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Fröliche Weihnachten

행 복 한 휘 알

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كلّ عام وانتم بخير

祝キリスト降誕

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Buòn Natále

शु भाशय:

Gladelig Jul

MERRY CHRISTMAS

С рождеством христовым

Ik wensch u een prettig kerstfeest

AN OFFICIAL PUBLICATION OF THE AMERICAN ASSOCIATION

OF INTEREST THIS MONTH

CARRIERS FOR FEED SUPPLEMENTS

FERTILIZING WHEAT FOR PROTEIN CONTENT

USE OF FUNGAL PROTEASE IN BAKING

REEL TYPE OVENS

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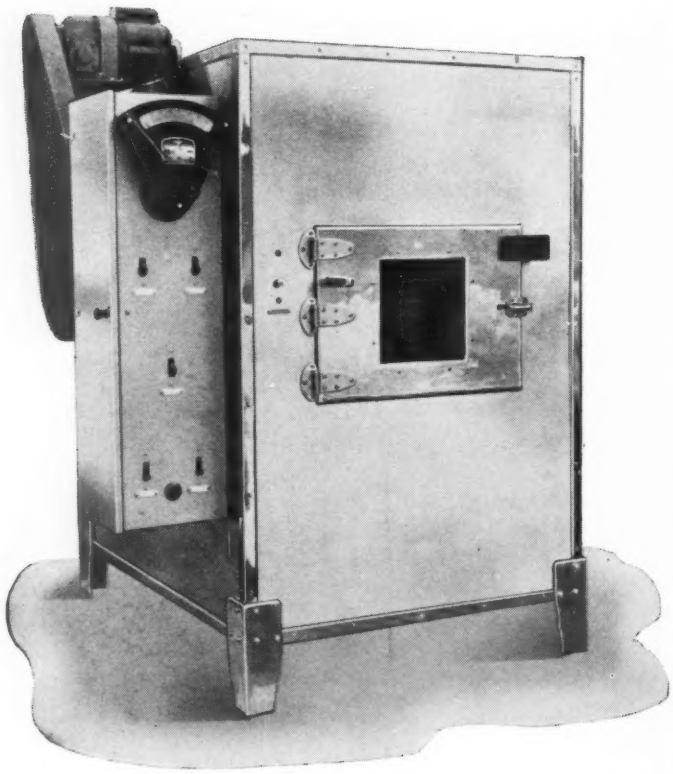

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INSIDE SCIENCE

THE VITAL STORY OF

Breakfast Cereals

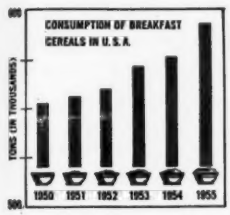
with essential vitamins and minerals restored

by Science Writer

New Edition

AMERICA LIKES BREAKFAST FOODS

Let no one doubt the popularity of breakfast cereals among Americans. The chart below traces the consumption of these fine foods between 1950 and 1955. During that period annual consumption rose by *76,000 tons.* In just one year, 1955, Americans ate 2½ lbs. of hot and 4.8 lbs. of cold cereals per person!



Why are breakfast cereals so well-liked? They are tasty; they are easily served; they appeal to busy homemakers, as well as institutional dietitians, because they are readily available in a variety of flavors at a modest cost. They add interest and value to an important but sometimes neglected meal—breakfast. Their use is extending to between-meal and party snacks, too.

Many grains are processed to make breakfast cereals: wheat, corn, oats, rice. Eaten with fruit and milk or light cream, they contribute an excellent combination of basic, flavorful, nutritious foods to the diet.

Better Foods for Better Health Through Restoration

The science of nutrition has advanced rapidly. In the manufacturing process of some cereals, some of the essential "B" vitamins and minerals are subject to some loss, just as with other foods. These losses are inescapable when such grains are prepared for human use. When this became known, manufacturers acted to overcome the losses. They adopted restoration.

Restoration simply means that certain important vitamins and minerals are restored to the cereal food during processing, so that the vitamin and mineral values in the finished product are generally equal to the whole grain values of those elements. Wheat, corn and rice products are customarily so treated. Vitamins B_1 (thiamine), B_2 (riboflavin), niacin (another "B" vitamin), and the mineral, iron, are those most widely restored. Vitamins C and D are also sometimes added.

Pre-sweetened cold cereals emphasize the nutritional importance of added vitamins. Increased calories require more "B" vitamins for best utilization of the food.

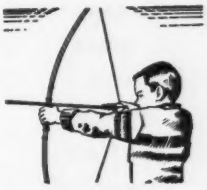
Why the Vitamins are Important

Physicians and diet experts have proved that vitamins are essential to prevent certain deficiency diseases and to contribute to robust good health.

Vitamin B_1 (thiamine) helps build and maintain physical and mental health. It is essential for normal appetite, intestinal activity, and sound nerves. A lack of this vitamin leads to beriberi, a rarity in the U. S. A., but still a very serious health problem in other parts of the world.

Vitamin B_2 (riboflavin) is essential for growth. It helps to keep body tissues healthy and to maintain proper function of the eyes.

Niacin is needed for healthy body tissues. Its use in the American diet has been largely responsible for the virtual disappearance of pellagra, a serious disease.



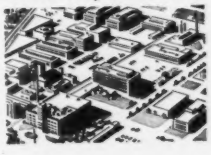
Vitamin D helps children develop normal teeth and bones. It prevents the development of certain abnormal bone conditions in adults.

Iron is essential for making good red blood and for the prevention of nutritional anemia.

Where Do the Vitamins Come From?

At about the same time that processing losses in breakfast cereals became known, other developments in the scientific world made available ample supplies of vitamins at economical prices. Thus, the nutritional contribution of some breakfast cereals could be, and was, greatly improved through restoration.

Since the early days of breakfast food restoration and of white flour and white bread enrichment, the world-famous firm of Hoffmann-La Roche has supplied top quality vitamins *by the tons.* Pioneering work in its laboratories and by its collaborators resulted in the "duplication" of some of nature's extremely complex substances. First, the chemical composition of the vitamin was learned. Second, the pure substance was isolated. Third, the "duplicate" was made by synthesis. And fourth, the laboratory techniques were extended to large scale commercial operations.



The manufactured "duplicate" is identical chemically and in biological activity with nature's own product. A vitamin is still a vitamin regardless of whether nature or man made it. So efficient is large-scale manufacturing, that vitamins are sold at a lower cost than if they were extracted from natural sources.

This article is one of a series devoted to the story of vitamin enriched or restored cereal products: white flour, white bread and rolls, corn meal and grits, macaroni products, white rice, breakfast cereals, farina. Reprints of this article, of any other in the series, or of all are available without charge. Please send your request to the Vitamin Division, Hoffmann-La Roche Inc., Nutley 10, New Jersey. In Canada: Hoffmann-La Roche Ltd., 1956 Bourdon Street, St. Laurent, P. Q.

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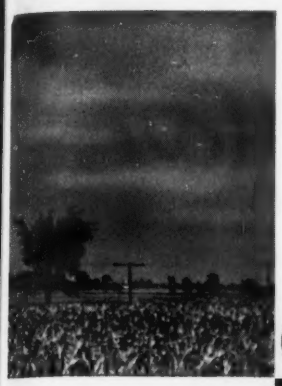

CEREAL SCIENCE today

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TECHNICAL SECTION

DEPARTMENTS

STAFF

COVER: "Season's Greetings" designed by Nancy Lein.

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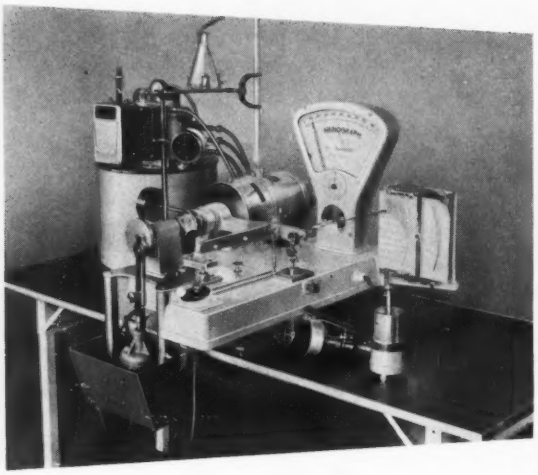

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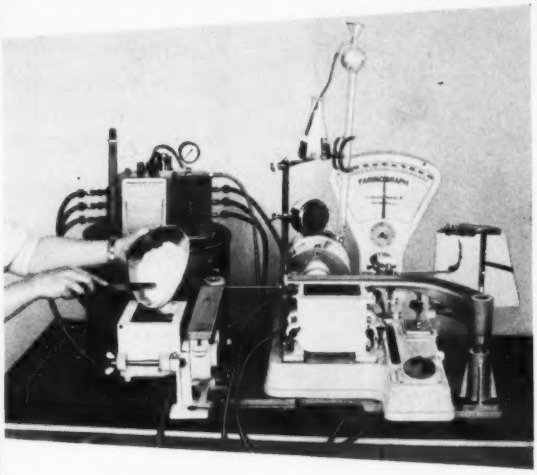

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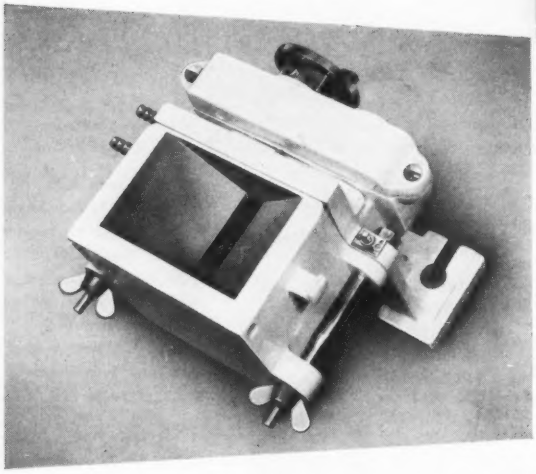

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Editorial

KEEPING UP WITH the latest development in one's field is a responsibility that is assumed by most technologists. Indeed, few things can depreciate the value of a scientific education faster than failure to continually add to it. Reading is one of the most effective ways of continuing the educational process throughout life. Reading skill is required to absorb what a college education has to offer. Beyond college each individual determines what his own reading program is to be. Journals such as those of this Association and many others are devoted to making this task easier.

With so many current publications demanding our attention, it is not surprising that most of us spend little time browsing through shelves of old journals or refreshing our knowledge of basic facts and principles by rereading text and reference books. University professors frequently find during oral examainations of advanced degree candidates that the student's knowledge of recent scientific advances may be more complete than his recollection of the fundamentals on which these have been built. In industry unnecessary time and money may be spent in the laboratory if someone doesn't check the literature to find out what facts have already been established or to learn how needed information can be obtained most reliably and efficiently through proper experimental design.

Scientific knowledge in all fields, pure and applied, is expanding at an ever increasing rate. The challenge to educators is to most effectively teach principles and how to find needed facts. The challenge to all of us is to add to our knowledge without forgetting those basic principles that enable us to discriminate; to keep our minds free to think by forgetting details without forgetting where to find them again when we need them.

PAUL E. RAMSTAD

IMPORTANT ASPECTS OF CHOOSING

Carriers for Feed Supplements

By W. L. Benson, R. J. LaPierre, and J. F. Mahoney*

As our information about the nutrition and diseases of poultry, swine, and other livestock has increased, it has become customary to fortify manufactured feed with a variety of ingredients designed to produce a well-balanced ration with optimal nutritional, growth-promoting, and feed-efficiency properties. Many feeds are medicated with drugs whose purpose is to prevent or control outbreaks of certain diseases. Often these added ingredients are required in extremely small quantities and are called microingredients. Their use will vary with the type of animal, age of the animal, and the composition of the other ingredients used in the feed formulation.

It has become common practice to supply these microingredients to the feed manufacturer in the form of supplements formulated to meet his specific requirements. General factors involved in the design of such supplements have been described in previous articles by the authors (1, 2). For the purposes of this discussion, it is sufficient to point out that the use of feed supplements permits 1) dilution of microingredients to a volume or weight more readily handled in a feed mill; 2) elimination of separate handling by combining several microingredients in the same supplement; 3) standardization of activity; 4) stabilization of ingredients which are normally unstable or incompatible with other substances; and 5) alteration of physical properties to a form which is conducive to ready and uniform distribution of microingredients in the feed.

One of the most important items in the design of a feed supplement is the choice of the carrier or diluent, since the supplement will tend to approach the carrier in general appearance and in physical properties. Frequently, the choice of carrier may be the only flexibility permitted the formulator. Let's look at the factors which must be considered in selecting the carrier.

* Chemical Division, Merck & Co., Inc., Rahway, N.J.

General Considerations

Obviously the carrier must be one which is economical, readily available throughout the year, well standardized as to physical properties and composition, and acceptable for feed use. Such requirements are ordinarily not a problem if the carrier is a grain product used commonly in feeds. These factors, however, must be given prime attention if an unusual carrier is being considered.

Other rather obvious specifications are:

1. The carrier should be available in a condition where there is little or no likelihood of insect infestation. If not, routine fumigation may be required before use.

2. The carrier should be reasonably stable insofar as rancidity, mold growth, and hygroscopicity are concerned. Unless the proportion of soluble matter in the carrier is low, difficulty with caking during humid weather can be expected.

3. The carrier should not contain substances likely to be incompatible with microingredients. Some of the clays, for example, are strong absorbing agents and catalyze destruction of vitamin A. Certain inorganic carriers may have a pH likely to promote destruction of sensitive ingredients.

Some of the materials which have been used or considered as carriers are listed.

Particle Size of Carrier

The preferred particle size of the carrier represents a compromise between several objectives. Generally speaking, if the carrier is too coarse it may lead to poor distribution of the supplement in feed, and some of the powdered microingredients may separate from the carrier. If the carrier is too fine, it will lead to a dusty supplement with poor flow properties, and caking tendencies may be increased.

Unless the carrier is produced by a screening operation, a narrow control over mesh range is not practical and one must be content with the somewhat broader mesh range

Carrier Materials for Feed Supplements

SOURCE	CARRIERS
Grain products	Corn meal; hominy feed; corn distillers' dried grains; soybean meal; soya grits and soya flour; wheat middlings; farina; rice grits and rice bran; crimped oats and oat meal; brewer's grains; malt sprouts
Minerals	Limestone; oyster-shell meal; salt; clay; talc
Animal by-products	Fish meal and dried fish solubles; meat scraps; tankage; bone meal; dried whey and dried milk solids
Miscellaneous	Antibiotic mycelia; fermentation solubles; distillers' solubles; molasses solubles; dried yeast; dried citrus meal

achieved by milling. We have found the following mesh range a practical optimium for most feed supplement carriers:

	%
On 10	0
10–20	5
20–30	10
30–60	30
60–100	40
100–200	10
200–325	5
Through 325	0

Importance of Particle Shape

Most supplements are prepared by the dry blending of microingredients with the carrier. Up to a point, microingredients in the form of powders will adhere tenaciously to the coarser carrier particles and will not segregate even under severe physical treatment. It is very important that this point, the powder capacity of the carrier, be established and not exceeded. Although powder capacity is determined in part by the mesh of the carrier, it is important to recognize that two carriers having identical mesh analyses may show widely different powder capacities. This difference is largely a matter of the surface area of the particles, which in turn is a function of particle shape and surface texture.

Generally speaking, particles with a smooth flat surface have poor powder capacity, whereas those with a highly irregular surface will hold powders well.

As an illustration, uniform mixtures were prepared with different quantities of sulfaquinoxaline, a powdered microingredient, using several carriers of comparable mesh analysis. The mixtures were subjected to severe agitation while an air stream was blown through to remove loosely held particles of sulfaquinoxaline. The mixtures were then analyzed for sulfaquinoxaline content and uniformity. The table below shows the maximum percentages of sulfaquinoxaline tenaciously held by the carriers studied, and provides a means by which these carriers can be rated for powder capacity:

	Powder Capacity As Percent Sulfaquinoxaline
Corn distillers' dried grains	12
Wheat standard middlings	10
Corn meal, ground	8
Soybean meal, solvent-extracted	2

The adherence of powders to carriers depends on the nature of the powder ingredients as well as the carrier. By conducting experiments similar to that described above, and determining the powder capacity of one carrier for a number of different microingredients, it is possible to rate these microingredients for carrier adherence. Typical ratings are shown in Table I.

Table I. Powder Capacity of Carriers

Carrier	*Riboflavin*	*Sulfaquinoxaline*	*Nicarbazin*
	%	%	%
Corn distillers' dried grains	20	12	10
Wheat standard middlings	15	10	8
Corn meal, whole ground	12	8	6
Soybean meal, solvent-extracted	3	2	2

It has been our experience that such ratings developed with one carrier are applicable to other carriers; moreover, where several powders are involved, their effects are additive. Thus, if one has accumulated sufficient information on the powder capacities of carriers and on the carrier adherence of microingredients, it is possible to predict with considerable reliability the segregation properties of any mixture involving these components. Such a technique is particularly useful in cases where a large number of proposed supplement formulations must be evaluated.

Mixtures with Coarser Microingredients

Where one is involved with the problem of preparing supplements from relatively coarse microingredients, the powder capacity effects discussed previously have a minor influence. It is more important that a carrier be chosen which matches the microingredients closely in particle size distribution, particle shape, and density. In most instances that we have encountered, the grain carriers we use for powders will handle coarser microingredients. On the other hand, excellent mixtures can often be made with coarse microingredients using carriers of low powder capacity.

Special Carriers for Microingredients

A few of the microingredients used to fortify feeds are unstable to water and may undergo gradual decomposition if mixed with a grain carrier which normally contains moisture amounting to several percent. Wherever possible it is preferable to stabilize such ingredients independently, such as through use of stable derivatives, physical coating, or pH control, in order to retain flexibility in formulation design. An alternate method is to use an anhydrous carrier. Oyster-shell meal and ground limestone may be suitable as carriers in such instances, although their powder-carrying capacity is relatively low.

Water-soluble microingredients may be hygroscopic and cause the feed supplement to cake. The most common instance of this is choline chloride, which is not far removed from concentrated sulfuric acid in its affinity for water. Fortunately, several of the better grain carriers such as corn distillers' dried grains, wheat standard middlings, and brewers' grains have the ability to absorb rather large amounts of aqueous solutions without caking. Where high levels of hygroscopic microingredients are involved, it is preferable to absorb a concentrated solution in the carrier, dry the mixture, and use this product as the ingredient in the formulation.

A significant improvement in the powder-carrying capacity of a carrier can be achieved by adding vegetable oil or by selecting a form of the carrier with a naturally high oil content. Table II gives an illustration of this.

Table II

Effect of Oil on Powder-Carrying Capacity

Carrier	*Oil*	*Capacity for Riboflavin*
	%	%
Soybean meal	0.6	3
	2.6	5
	4.6	8
Corn meal		
Solvent-extracted	0.8	4
	2.8	8
	4.8	14
Natural	4.1	12
Corn distillers' dried grains		
Extracted	0.7	7
	4.7	13
Natural	7.8	20

Literature Cited

1. Mahoney, J. F., and Benson, W. L. Symposium on medicated feeds, pp. 74–82. Medical Encyclopedia, Inc.; New York (1956).
2. Mahoney, J. F., and Benson, W. L. *Cereal Science Today 2:* 33 (1957).

CEREAL LABORATORY METHODS

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WHY RESTRAINT IS NECESSARY IN

Fertilizing Wheat for Protein Content

By Harold V. Eck*

ANYTHING THAT WE do with a given wheat variety to increase yields, short of adding nitrogen to the soil, will tend to decrease grain protein. This includes insect control, disease control, irrigation, fertilization with other than nitrogen fertilizer, cultural practices which tend to conserve moisture, and other means of increasing yields. Increased grain yields without additional nitrogen simply dilute the nitrogen which is available and we get higher yields without proportionately higher nitrogen uptake.

To illustrate this point, let us look at some yield and protein data from Billings, Oklahoma, in 1953. Unfertilized plots yielded 19.3 bu. per acre of 11.8% protein wheat. Phosphorus-fertilized plots yielded 24.8 bu. per acre of 10.2% protein wheat. The unfertilized plots yielded 137 lb. of protein per acre and the phosphated plots, 152 lb. of protein per acre. Had the grain protein percentage on the phosphated plots been equal to that on the check plots, 177 lb., or 40 additional lb. of protein would have been required. We see that the soil was able to supply nitrogen for only 15 of the needed 40 lb. of protein. Data from the same experiment show that it would have cost the farmer 12 cents per bushel for nitrogen fertilizer to have brought this wheat up to 11.2% protein, and 24 cents per bushel to have brought it up to 12.2% protein.

Protein Yield vs. Soil Nitrogen

We see now that within the genetic capabilities of any one variety, grain protein tends to be a function of soil nitrogen level. We can fertilize with nitrogen and increase grain protein to the point at which the genetic properties of the variety limit further increase. In fact, we can fertilize for yield alone, for protein alone, or for both yield and protein. For yield alone, we would fertilize with needed quantities of nonnitrogenous fertilizers (phosphorus and potassium) and with only sufficient nitrogen to give maximum yield increases. In this instance, we would probably produce wheat with lower protein than if we had applied no fertilizer. For protein alone, we would apply nitrogen on soils which produce grain protein below the genetic capability of the variety, and apply it too late for any increase in yield but early enough to increase protein. Here, we would increase protein without affecting grain yield. For both yield and protein, we would fertilize with needed nonnitrogenous fertilizers and with nitrogen in excess of the amount required for maximum yield. We would apply the nitrogen early enough for yield increases. The nitrogen in excess of that required for yield increases would go towards protein increases. We can accomplish the same results by applying part of our nitrogen early for yield response and the rest of it after yield is determined to get protein response.

What does it take, in terms of nitrogen, for both yield and protein increases? That, of course, depends on the season. We know that in seasons when we have high yields, protein tends to be low and in those when we have low yields protein tends to be high. To illustrate, let us look at data from two seasons, 1951–52, and 1952–53 (Table I).

Table I. Wheat Yields and Grain Protein Percentages in Western Oklahoma Wheat Fertility Trials—1951-52, Four locations, 1952-53, Nine locations

Nitrogen	*Yield*		*Protein*	
	1951–52	1952–53	1951–52	1952–53
lb/A	bu/A	bu/A	%	%
0	29.6	26.5	9.6	12.5
20	35.3	28.0	9.8	12.8
40	39.8	27.5	10.2	13.3
80	41.9	27.9	11.4	14.8
160	...	27.2	..	15.6

Since there were but four locations for 1951–52 and nine for 1952–53 we cannot make direct comparisons, but it is easy to see that in 1951–52 yield responses were good, with relatively small changes in protein, whereas in 1952–53 yield response was slight but protein increases were considerable. One cannot set a definite figure for pounds of nitrogen required for a given increase in protein, but if we take the 1952–53 data, when yield increase was slight, we see about 40 lb. of nitrogen were required to give a 1% increase in grain protein. With nitrogen at 15 cents per lb., the protein increase cost 22 cents per bu. for each 1% increase in protein.

Economic Considerations

At the present time it is not economically feasible to fertilize for protein. If wheat were sold on the basis of protein or at least some premium were offered for high-protein wheat, there would be more of it. Farmers could better afford to use nitrogen fertilizer if they had a price as well as a yield incentive. In seasons when grain yield is not affected by nitrogen fertilizer, grain protein is affected, and vice-versa. At the present time premiums are offered for high protein in seasons when wheat protein is relatively low and not when it is

(Please turn to page 296)

* Soil Scientist, Soil and Water Conservation Research Division, Agricultural Research Service, Southwestern Great Plains Field Station, Bushland, Texas. Formerly jointly employed by the Oklahoma Agricultural Experiment Station, Stillwater, Oklahoma.

USE OF FUNGAL PROTEASE IN THE BAKING INDUSTRY[1]

G. REED and J. A. THORN, Red Star Yeast and Products Co., Milwaukee, Wisconsin

ENZYMES CATALYZE ALL biological processes in animal and vegetable tissues and within all cells of microorganisms. The tremendous diversity of life processes and their complexity are reflected in a correspondingly large diversity, specificity, and complexity of enzymes. The production of microbial enzymes on an industrial scale deals with only a few groups of enzymes which can be readily isolated. These are usually enzymes which cause the hydrolytic breakdown of food colloids into their low-molecular-weight building stones. The bulk of the microbial enzymes produced commercially today are those which hydrolyze starches to dextrins and sugars (amylases), and proteins to peptides and amino acids (proteases). The principal generating organisms are various species of *Aspergillus* and *Bacillus*.

These organisms are generally grown in submerged, liquid culture in a nutrient medium and with vigorous agitation and aeration of the medium to supply oxygen (aerobic growth). Fermentation tanks range from 5 to 25,000 gal. in capacity. They are closed systems permitting sterilization of the medium at temperatures exceeding 100°C. The medium is inoculated with a pure culture of spores of the generating organism from culture tanks of smaller size. Throughout the growing period sterile air is pumped through the medium, and the pressure inside the tanks is kept higher than on the outside to prevent contamination.

Production of Fungal Protease

The growth period for *Aspergillus oryzae*, which is used for the production of proteases for the baking industry, is generally between 24 and 36 hours at temperatures between 30° and 40°C. The nutrient medium usually consists of a source of protein, such as corn steep liquor, as well as carbohydrates, nutrient minerals, and buffer salts (8). The liquid medium is agitated by the air which enters the tank through spargers. However, additional agitation by means of motor-driven blades is usually provided. Larger tanks also require heat-exchange systems to provide cooling during the active-growth phase of the organism.

Proteolytic, amylolytic, and pectic enzymes, as well as oxidases and many other enzyme systems, are secreted by the growing organism into the liquid medium. After the time required for maximum protease production, the liquid portion of the spent medium containing this and other enzymes is separated from the fungal mycelium by filtration—usually continuous vacuum or pressure filtration—or centrifugation. The enzyme concentrate is then obtained from the liquor by precipitation with organic solvents, such as methyl, ethyl, or propyl alcohol (acetone, which is commonly used in laboratories, is rarely used commercially), or by salting out with inorganic salts. The resultant precipitate contains the proteolytic enzymes, together with other enzymes and nonenzyme protein excreted by the fungus. Since there are several and probably many separate proteases, and since these have not been crystallized and characterized, it is not possible to say what percentage of the precipitate consists of proteolytic enzymes.

In the production of proteases for the baking trade no attempt is made to separate these enzymes from other enzyme systems, and fungal proteases currently in commercial use contain significant amounts of amylases. These amylases are never harmful and are frequently helpful in bread-baking, and their removal by preferential destruction or by separation would serve no useful purpose.

The precipitate formed after addition of solvents or salt is air-dried to a moisture content of 8% or less. Its proteolytic activity varies somewhat from batch to batch, since it depends not only on the amount of protease secreted by the organism but also on the amount of protein and other enzymes which are coprecipitated. The dried precipitates are potent enzymes, often having activities of 100,000 hemoglobin units (H.U.) or more per g. They are designated as fungal protease concentrates (16).

Assay Methods

The hemoglobin method of Ayre and Anderson as modified by Miller (3, 15) has been used widely to determine the activity of fungal proteases sold to the baking trade. The extent of hydrolysis of hemoglobin is measured by determining the nitrogen which remains soluble after addition of trichloroacetic acid. A gelatin viscosity method has been suggested as suitable by Koch and Ferrari (12). Both methods are sufficiently precise, and are useful as quality control methods for a given type of fungal enzyme preparation. There is no reason to expect that either of these methods will correlate with the activity of the enzymes in "mellowing doughs" (or in shortening mixing time), and, at least for the hemoglobin method, it has been shown that preparations of equal hemoglobin value may have widely different effects on doughs. This does not diminish the usefulness of these tests as precise quality control methods, but it suggests frequent cross checks with less precise but more accurate dough testing methods.

The dough test methods are based either on the farinograph or the mixograph, or on determinations of

[1] Manuscript received Oct. 17, 1957.

mixing time with laboratory dough mixers. Johnson and Miller (11) have used the farinograph to determine the viscosity of flour-enzyme-water doughs as a function of time. For a determination of protease activity it is necessary to add an excess of amylase to compensate for the effect of amylase on dough viscosity (Fig. 1). Figure 2 shows two interrupted farinograph curves which permit

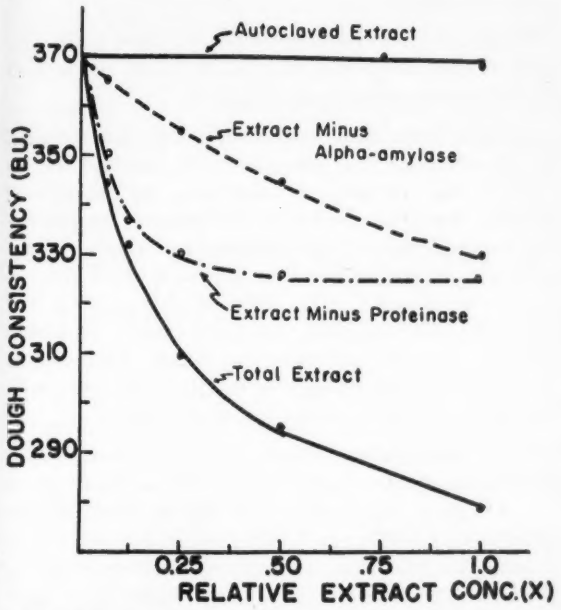

Fig. 1. Effect on dough consistency of normal fungal extract, extract containing protease but no amylase, extract containing amylase but no protease, and autoclaved extract (no protease or amylase) (see reference 11).

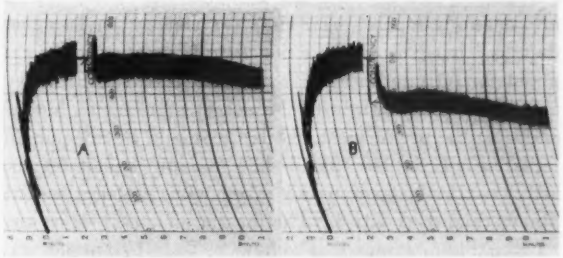

Fig. 2. Effect of protease on consistency of flour-water doughs (see footnote 2). Doughs mixed to optimal consistency, then rested 1 hour before mixing continued. A, flour-water mixture; B, flour-water-protease mixture.

an evaluation of the effect of proteases on dough viscosity.[2] Another possibility is the determination of mixing time to peak viscosity in the farinograph for sponge doughs based on a commercial formula.[3] The mixograph can be used in a similar manner, as shown in Fig. 3. An increase in dough extensibility as measured by the Extensograph® has been reported,[4] and this instrument may be applicable to the development of a better test method. Finally, a reduction in "pick-up" time for flour-water-enzyme doughs in laboratory mixers can be determined. For such tests an absorption of about 100% and an enzyme concentration of about 160 H.U. per 100 g. flour are recommended.[5]

[2] Personal communication; C. W. Brabender, C. W. Brabender Instruments, Inc.
[3] Personal communication; L. Atkin, Standard Brands, Inc.
[4] C. J. Dempster and I. Hlynka. Paper read at 41st annual meeting, AACC, New York, May 1956.
®Registered trademark by Brabender Corp., Rochelle Park, N.J.

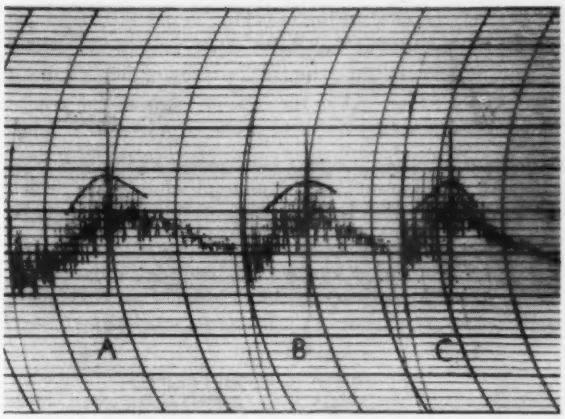

Fig. 3. Effect of protease on mixing times of flour-water doughs. Doughs rested 1 hour prior to determination of mixograms. A, no protease; B, 120 H.U. protease per 30 g. flour; C, 240 H.U. protease per 30 g. flour

Mixing time can also be determined in laboratory-size sponge doughs as a function of enzyme concentration by observation of dough development and by baking and scoring bread loaves. For this experimental baking the concentration of fungal protease should be about 80 H.U. per 100 g. of flour.

The dough testing and baking methods mentioned in the preceding paragraph lack precision, and therefore, cannot be used for quality control purposes. However, they are needed for comparative tests of enzyme preparations from different manufacturers, and they may serve as a useful guide for evaluating the response of particular flours to fungal proteases.

Commercial Preparations and Stability

Fungal protease concentrates are too high in activity to be used without dilution. The concentrates, which may contain more than 100,000 H.U. per g., are generally diluted with a clear grade of flour to a concentration of 300 H.U. per g. These powdered preparations may then be used by the baker at a rate of 4 oz. per 100 lb. of flour, and contribute about 35,000 H.U. Fungal proteases are also available in tablet form, either single strength (about 35,000 H.U.) or double strength (about 70,000 H.U.). For tabletting, the enzymes are premixed with excipients, mainly starch. The single-strength tablets are generally used at a rate of 1 tablet per 100 lb. of flour.

The stability of fungal proteases is excellent. Fungal protease tablets may be stored under trade conditions with average fluctuations of temperature and moisture for 6 months without any detectable loss in activity. Powdered preparations diluted with 13% moisture flour were stored at 30°C. for 6 months without loss of activity, and are most likely stable for longer periods.[6]

Legal Considerations

Fungal proteases derived from the mold *Aspergillus*

[5] Personal communication; E. A. Vaupel, Food Industries, Inc.
[6] Personal communication; C. V. Smythe, Rohm and Haas Co.

oryzae may be used in bread-baking under the Standards of Identity for Bread and Rolls. They may not be added by the mill to the flour under the present Standards of Identity for Flour. As in the case of many dough conditioners, oxidizing agents, and other adjuncts, it is questionable whether addition of such agents at the mill level is technically desirable. The amount of protease which is required in bread-baking depends not only on flour quality but also on bakeshop conditions, principally fermentation time and temperature. However, in some circumstances, for instance with flours sold for baking in the home, the addition of proteases may be useful.

Application in Bread-Baking

The application of fungal enzymes in the baking industry developed through a desire to replace malt amylases with mold amylases. Since the early fungal amylase preparations contained proteases also, the mellowing effect of proteases on doughs was readily observed. In many instances in which this mellowing effect was not wanted, it precluded use of such fungal preparations as sources of amylase. However, it soon became apparent that the mellowing effect of fungal proteases was desirable with stronger flours, and it was recognized that it was necessary to standardize fungal preparations on the basis of their proteolytic activity.

The pioneering work on the use of fungal proteases in bread-baking was done by a group of cereal chemists at Kansas State College during the 1940's (10, 14). A good deal of work has been done in the laboratories of milling and baking companies, but only a few studies have appeared in print (6, 9, 17). Fungal enzymes are now used widely in commercial baking, and addition to 50–80% of white pan bread production is probably a fair estimate. This includes both protease and amylase preparations.

Before the practical use of fungal proteases is discussed, the profound effect of salt on protease activity should be pointed out. Salt inhibits the effect of protease on gluten, although it does not seem to inhibit its effect on other proteins such as gelatin (12). Extensograph® work with salted (1%) and unsalted doughs also has been reported, and substantiates the practical observations (1). Consequently, the effect of proteases in straight doughs containing about 2% salt is negligible. Reports of improvements of loaf volume and grain with fungal proteases in straight doughs have been published in Europe. The results can probably be explained on the basis of the amylase activity of these fungal preparations.

Mixing Time. The mixing requirements of sponge doughs can be markedly decreased by protease. The enzyme is normally added to the sponge, where it acts on flour proteins during the fermentation period. Little effect is noticed if it is added with the dough ingredients, since it has insufficient time to act, and also because the dough salt inhibits its action. An illustration of the effect of protease was provided by Coles (6). Using a fungal preparation having ten times the proteolytic activity of wheat malt, he showed that mixing times could be decreased 16, 30, 45, 55, and 65% when the protease was employed at 1/16, ⅛, ¼, ½, or 1%, respectively. In order to have equal extensibility at the molder, the protease-containing doughs were undermixed. In the bakery, a too-drastic reduction of mixing time is, of course, undesirable since the possibility of overmixing becomes a problem.

Protease is not normally employed when active dry yeast is used as the leavening agent, as the yeast itself has a mellowing effect on the dough.

Dough Extensibility. Besides decreasing mixing time, protease increases the extensibility of doughs. The enzyme is thus of value in controlling the pliability of doughs, eliminating buckiness, and ensuring proper machinability. Improved loaf characteristics (better volume, greater symmetry, and usually improved grain and texture) are obtained (2, 17). This use of the enzyme is of particular importance when the baker cannot—or prefers not to—alleviate difficulties in dough machinability through customary changes in handling, such as alteration of fermentation, mixing, or floor times.

Grain and Texture. Protease has been found to improve grain, texture, and compressibility of bread crumb (7, 11). These improvements undoubtedly result from the greater extensibility, and better machinability, of the original doughs, and are a secondary benefit derived from the use of the enzyme. The primary benefits are unquestionably the reduction in mixing time and better handling properties of the dough.

Protease in Pre-Ferments. In brew doughs protease has less time to act on flour proteins, and mixing times are generally much longer than for conventional sponge doughs. Therefore, optimal concentrations of protease are about three times higher (5). The protease can be added to the pre-ferment or with the dough ingredients, but, if added to the pre-ferment, the latter should be adequately buffered (pH not less than 4–4.5) to avoid loss of enzyme activity. Pre-ferment bread made with protease scored higher than the controls. Part of the increased score was attributable to larger loaf volume.[7] Tests in our laboratory have shown that the principal advantage gained by use of protease is an increase in loaf volume. McGhee has employed protease mainly to reduce mixing time (13).

Protease in Twist Bread. Larger-than-usual amounts of protease are also used in twist bread (4). In this application the enzyme is effective because the increased relaxation of the dough results in the desired proofing characteristics.

Protease in Cracker Production. Protease causes cracker doughs to be more pliable and amenable to being rolled out. This prevents curling of the sheeted dough and burning of the raised portions, particularly along the edges, on baking. The number of cripples is greatly reduced, and the crackers are flat, uniform in shape, and

[7] Personal communication; J. A. Johnson, Kansas State College.

can be packaged without difficulty. Tenderness of the baked crackers is increased by use of the enzyme.[8]

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"NO-TIME" WHEAT-FLOUR DOUGHS IN SWEDEN[1]

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IN SEVERAL SURVEY articles (1–7) dealing with methods of making wheat bread, and the numerous references cited therein, little has been written concerning the principles involved in baking. The present article discusses fermentation practices used for wheat-flour doughs in Sweden.

Types of Wheat-Flour Doughs

Straight wheat-flour doughs are generally used, the bread being baked directly on the oven hearth or on flat baking plates. Fermentation and proofing times together usually are not more than 2 hours. Doughs are of two types (3) according to sugar content: Type 1 (for buns, rusks, and some kinds of white bread) contain sufficient sugar to enable the yeast to develop its full fermentation power during proofing; type 2 (for rolls and other kinds of white bread) contains insufficient sugar for this effect.

Calculation of Ingredients

Ingredients are calculated on the basis of weight per liter of dough liquid rather than flour employed. What are the reasons for this?

Since wheat flours in Sweden are milled from foreign high-protein wheats of various origins or from low-protein Swedish wheats, they often have variable water-absorption capacity. It is often an advantage, therefore, to calculate the amount of yeast per liter of dough liquid. A dough from flour with high water absorption has more yeast for a given dough weight than one from flour with low water absorption. This is desirable because, to ensure bread of good volume, dough from a strong flour requires more yeast than dough from a weak flour.

Average formulas for the most common Swedish wheat-flour doughs are given in Table I. To avoid confusion for American readers, formula ingredients are given in percentages of flour weight.

TABLE I

FORMULAS FOR WHEAT DOUGHS COMMONLY USED IN SWEDEN
(Percentages of flour weight)

INGREDIENTS AND CONDITIONS	STRAIGHT WHEAT DOUGHS OF TYPE 1			STRAIGHT WHEAT DOUGHS OF TYPE 2	
	Buns[a]	Rusks[a]	White Bread[b]	White Bread[c]	Rolls[c]
	%	%	%	%	%
Flour	100	100	100	100	100
Water	45–50	47–50	50–55	50–55	55–60
Nonfat dry milk	5.0	5.0	..	5.0	..
Compressed yeast	4–5	4–5	4–5	4–5	4–5
Sugar	15–20	5–10	4–5	..	..
Shortening	15–20	5–10	1–2	1–2	0–1
Salt	0.5–1	0.5–1	0.5–1	0.5–1	0.5–1
Malt syrup	..	..	..	0–1.5	0–1.5
Cardamon[d]	0.5–1	0.5–1	..	..	.
Temperature: dough (°F.)	74–82	74–82	74–82	74–82	74–82
fermentation cabinet[e] (°F.)	70–80°	70–80	70–80	70–80	70–80
Fermentation time (minutes)	10[5f]–60	10[5f]–60	10[5f]–30	45–75	45–75
Temperature: proofing cabinet (°F.)	95–104	95–104	95–104	95–104	95–104
Humidity at proofing (%)	75–80	80–85	80–85	85–90	90
Proofing time (minutes)	40–60	40–60	45–70	35–60	40–60
Oven temperature (°F.)	450–500	450–500	430–480	430–480	450–500
Oven time (minutes)	8–15	8–15	15–20	15–23	15–20

[a] Usually baked on baking plates.
[b] Usually baked in pans.
[c] Usually baked on the oven shelf.
[d] A condiment or flavoring popular in Sweden.
[e] The doughs are usually fermented in the bakery.
[f] Often practically no fermentation time is used.

Types of Flour

The types of flour most commonly used in Swedish bakeries, shown in Table II, are low in protein and are rather heavily treated with potassium bromate.

Quantities of Ingredients

Yeast: Gas production proceeds faster as the amount of yeast is increased, provided the sugar content is sufficient. Too much yeast, however, may impair gas retention and hence the "firmness" of the dough. Swedish wheat doughs (see Table I) usually contain about 4 to 5% yeast based on the quantity of flour, but some bread

[1] Manuscript received August 17, 1956.
[8] E. A. Vaupel. Paper read to the Biscuit and Cracker Institute, Chicago, Ill., April 1, 1954.

types, such as Wienerbröd (Viennese buns), have 8 to 10% or more or yeast, which will not affect consumer acceptance.

TABLE II

COMPARATIVE DATA FOR DIFFERENT SWEDISH FLOUR GRADES
(The aveargé data refer to flour with 15% moisture)

TYPE OF FLOUR	EXTRACTION	ASH	PROTEIN	POTASSIUM BROMATE	FLOURS USED
	%	%	%	p.p.m.	
Extra Short Patent	0–40	0.38	8.0	10–20	Pastries, cookies, cakes
Short patent	0–65	0.40	8.5	15–25	Same as above
Common	0–75	0.48	9–9.5	25–35	Buns, rusks, white bread, etc.
Special	40–70	0.48	9.5–10	40–50	Rolls, etc.

[a] Swedish wheat flours are usually enriched with thiamine, riboflavin, niacin, and iron, essentially in accordance with American standards.

Sugar: Doughs of type 1 (Table I), for buns, rusks, and some white breads, contain 15–20%, 5–10%, and 5% sugar, respectively. In some types of buns requiring a high degree of sweetness, as much as 30 to 40% sugar is used.

Doughs of type 2, for rolls and other kinds of white bread, contain little sugar (maximum 1–2%). The sweet taste and the fine bread pores produced when sugar is added to this type of dough are considered undesirable in Sweden. Consequently, malt extract must often be employed to improve the sugar-forming capacity of the dough.

Shortening: A rather large amount of shortening is used in buns and rusks, for taste and keeping quality. Less is used in other doughs, for better volume, grain, and texture (see Table I).

Salt: Approximately one-half as much salt is used in Swedish as in American bread doughs (see Table I). Only in a few Swedish wheat-flour doughs, such as those used for long rolls (called "baquette" in France), is 1½ to 2% of salt used.

Temperatures and Proofing Time

The usual temperatures for Swedish wheat doughs are 74° to 82°F.; the higher temperatures are usually employed with shorter fermentation times. In the fermentation cabinet, which usually is the bakery itself, the temperature generally lies between 70° and 80°F. The proofing cabinet is usually held at 95°–104°F. Proofing time of 40 to 60 minutes is customary.

Technique for Little or No Proofing Time

Proofing time is shortest for doughs of type 1, because gas production is much faster and there is little need of gas retention power and "firmness" in these doughs. This rapid gas production is obtained mainly in three ways:

1. Approximately 5% yeast and sufficient sugar (at least about 5%) enable the yeast to develop full fermentation throughout the proofing period (see Fig. 1).
2. Dough temperatures are high (77°–86°F.).
3. Temperatures in the proofing cabinet are comparatively high (95°–104°F.).

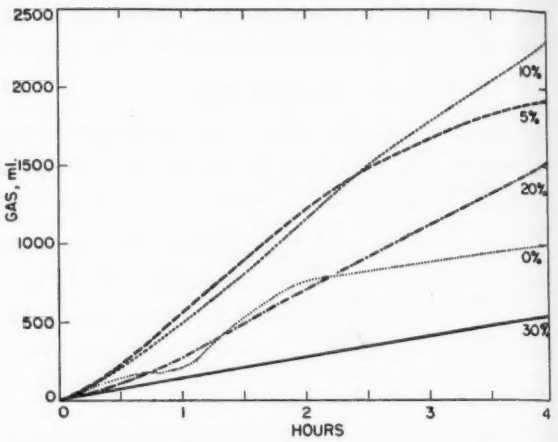

Fig. 1. Gas production, in ml. per 100 g. of flour (15% moisture content), in doughs made from the same flour but varying in quantity of sucrose added. The gas production was determined at 35°C. in the SJA-Meter (Made by Svenska Jastfabriks AB, Stockholm, Sweden), and was measured immediately after mixing. Dough composition: Flour, 100 g.; water, 50 g.; yeast, 5 g.; sucrose, varying; salt, 0.5 g. Dough temperature, 25°C. The flour was commercial Swedish flour having normal gassing power, ash 0.41%, protein 8.4%.

Figure 2 shows gas production, greatest at 115°F., in a dough of Swedish baker's flour, at various temperatures in the proofing cabinet of the Fermentometer (4).[2] Gas

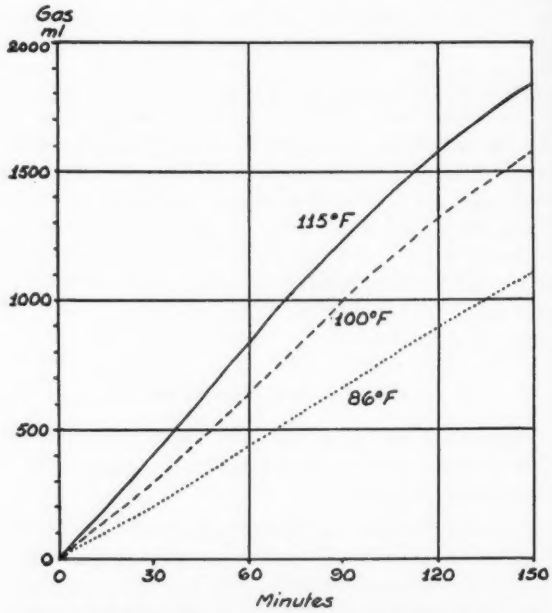

Fig. 2. Gas production of a dough of Swedish baker's flour determined at different temperatures in the proofing cabinet of the Fermentometer. Dough composition: flour (extraction 40-70%), 100 g.; water, 57.5 g.; yeast, 5.7 g.; sucrose, 5.7 g.; shortening 1.0 g.; salt, 0.6 g. Dough temperature, 86°F. Fermentation time, 30 minutes.

retention, however, is greater at 100°F. than at either 86° or 115°F. (Fig. 3). Greatest bread volume also is obtained at about 100°F., and Swedish bakeries generally use this proofing cabinet temperature. When time is short the temperature may be raised to 113°F. or even 122°F.,

[2] The Fermentometer is described in a recent article by Hagberg (see ref. 4).

but more than 104°F. is not recommended because of ill effects on grain and texture in the bread.

Gassing power (at 35°C.) in doughs made with different amounts of sugar is shown in Fig. 1. In doughs of type 2, the rate at which maltose is formed by the cleavage of starch is the limiting factor in the rate of fermentation, as the concentration of yeast is usually large.

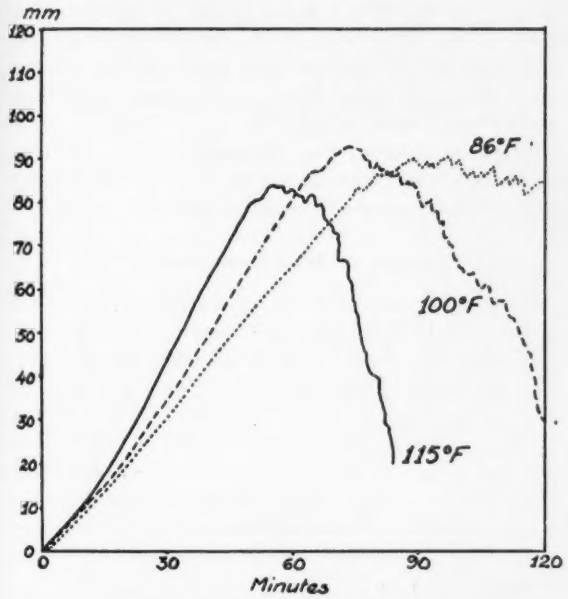

Fig. 3. Gas retention of a dough of Swedish baker's flour determined at different temperatures in the proofing cabinet of the Fermentometer. Dough composition and fermentation time same as in Fig. 2. Maximum bread volume was reached at 100.5°F. proofing temperature.

Recent Improvements in Baking Practice

While low-speed mixers of the Artofex or Werner Pfleiderer type are in general use, a continuous, automatic mixer[3] has recently been introduced (Figs. 4 and 5). The dry ingredients (flour, sugar, salt, etc.) and the homogenized fluid (water, sirup, melted shortening, yeast, etc.) are separately fed in and mixed for 1.5 to 3 minutes. The dough is fed continuously to a conveyor and reaches the divider after about 15 minutes.

A special proofing cabinet for molded dough pieces suggested by the author, having a covered and suitably heated conveyor with a cotton belt, has now been in use for about 10 years in some Swedish wheat-bread factories (Fig. 6). A divider and molder such as the Derby machine (Fig. 7) feeds dough pieces directly to the proofing conveyor.

The Corona bread factory in Sundsvall, the first in Sweden to adopt the "continuous-belt proofing" system, has an automatic system consisting of mixer, divider, and molder, "belt-proofer," tunnel oven, cooling conveyor for the buns, bun-cutting machine, rusk-dryer, and conveyor (Fig. 8). With one man as supervisor, this system is constructed to turn out 170,000 to 200,000 rusks (about 11 g. each) in 8 hours.

[3] J. Holmströms Machine Co., Stockholm, Sweden.

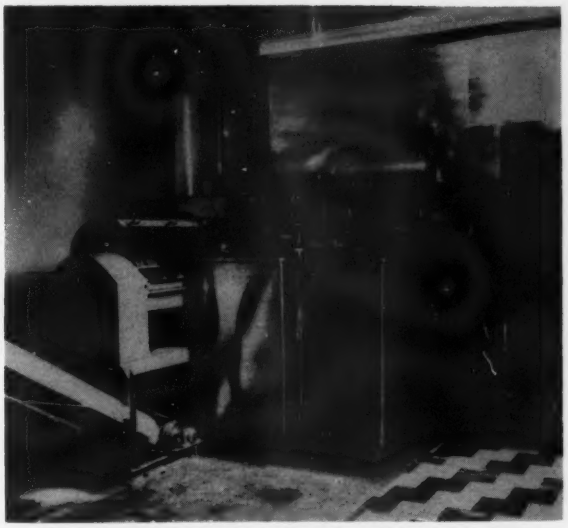

Fig. 4. Continuous dough mixer.

Fig. 5. Part of a continuous dough mixer shown in Fig. 4.

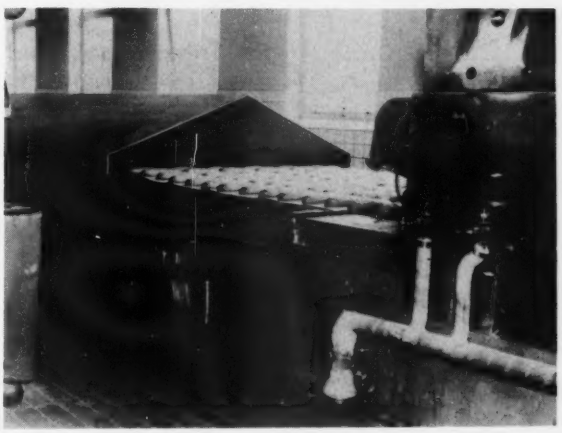

Fig. 6. Conveyor used as proofing cabinet, continuously feeding the proofed dough pieces into the oven.

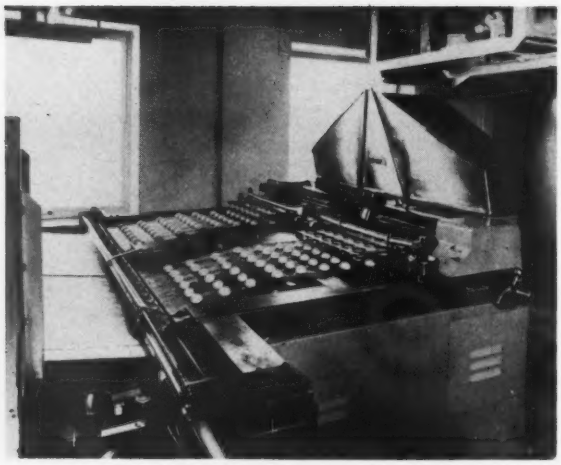

Fig. 7. Divider and molder.

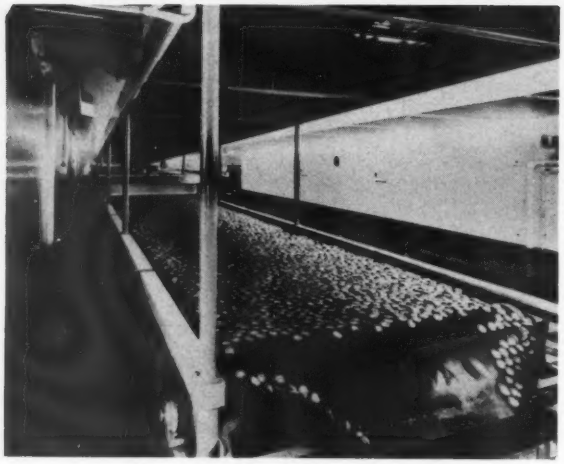

Fig. 8. Rusks going to packaging department.

Short Fermentation Time for High-Protein Flours

High-protein Manitoba wheat flours, sometimes used instead of Swedish flours which are comparatively low in protein, will yield a bread volume of approximately 1000 ml. per 100 g. flour (2, 3), with about 30 minutes' fermentation time and somewhat higher dough temperatures. Generally, good bread can be made using high-protein flour, with doughs of type 1 and 15 to 30 minutes' fermentation time, depending on the potassium bromate content. With doughs of type 2, a fermentation time of 45–60 minutes is usually required.

Advantages of Short Fermentation Time

The short fermentation time is of great advantage in Sweden, since night work in bakeries is forbidden by law. Bakers employed in dough mixing begin at 4 a.m., others at 6 a.m. Thus, the fermentation time must be short if customers are to get fresh bread in the morning.

The author has long advocated a reduced fermentation time, for reasons of economy, since it is more economical to use sugar as food for human beings than yeast. A general reduction of fermentation time by even one hour should save considerable money for bakers and for the country as a whole.

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7. Symposium on bread-baking test. *Trans. Am. Assoc. Cereal Chemists 8:* 113 (1950).

ERRATUM

Cereal Science Today, Vol. 2, No. 7, September 1957, page 186 The author regrets that the following correction is necessary in the above article:

Under the section headed "Formulation", lines four to seven should read as follows: " . . . per 100 pounds of flour, water 60–67%; sugar 7–10%; yeast 2–3%; shortening 3%; milk 2–6%; salt 1.5–2.5%; and yeast food (Arkady or Fermaloid type) 0.25–0.5%. Because . . . "

People, Products, Patter

. . . People

Stanley A. Bobrowski, Jr., promoted to assistant plant manager at Yeast Plant No. 2 of Anheuser-Busch, Inc., Old Bridge, N.J., from process manager.

Frank J. Hale, president of the National Yeast Corporation, awarded an honorary degree of Doctor of Laws from the Institutum Divi Thomae, Cincinnati, Ohio.

Cloy B. Knodt appointed research farm director for Cargill, Inc., at the Cargill-Nutrena Research Farm, new research center at Elk River, Minn.

Robert B. Koch, formerly with J. R. Short Milling Co., Chicago, appointed chief of the Chemistry and Microbiology Branch, Quartermaster Food and Container Institute.

S. Kuhl leaves Ogilvie Flour Mills, Winnipeg, for a new post at the North Dakota State Mill, Grand Forks, N. D.

Daniel McPherson, General Mills, Sperry Division, transferred to the San Francisco area.

Charles S. McWilliams, formerly of Quartermaster Food and Container Institute, now with the American Institute of Baking.

Howard J. Newman joins Sterwin Chemicals, Inc., as specialist in the field of animal nutrition.

Byron S. Miller, associate professor in the Department of Flour and Feed Milling Industries, Kansas State College, Manhattan, Kansas, will leave next June for England. Miller, who has been awarded a post-doctoral fellowship from the National Science Foundation for 15 months, will go to Rothamsted Experimental Station, Harpenden, Herts. He will work on the biochemistry of wheat plant resistance to diseases, and also will spend

some time at the Cereals Research Station at St. Albans and at several other plant-research and cereal-evaluation stations in England and other European countries.

Paul Snell now associated with Baker Process Co. division, Wallace & Tiernan, Belleville, N. J.

Tom Snowden, formerly of Canada Packers, Ltd., now with Monarch Creamery Products, Ltd.

Earl Spotts joins Continental Baking Co., Rye, N.Y.

. . . Products

C. W. Brabender Instruments, Inc., of South Hackensack, N.J., will exhibit several new pieces of equipment at the 26th Exposition of Chemical Industries, Coliseum, New York City, Dec. 2 to 6. On display at Booth No. 342 will be a variable speed Plastograph, Rapid Moisture Tester, Shortening Rheometer, Consistometer, and Cement Slurry Plastograph.

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A new production model of the Walther air classifier has recently been developed. Called the No. 1000, this classifier has a capacity of approximately 50 cwt. of flour per hour at a power consumption of approximately 35 H.P. For detailed information, write to Miag Northamerica, Inc., 1616 South 8th Street, Minneapolis 4, Minn.

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A. R. Aikman, Schlumberger Well Surveying Corporation, reports recent significant developments in analysis instrumentation in an article called "Process Control by Analytical Instrumentation." The 8-page illustrated paper examines nuclear magnetic resonance and other new analytical processes as improvements in control and detection techniques. Schlumberger Well Surveying Corporation, Ridgefield, Conn., will send copies on request.

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A new line of Selectrol automatic checkweighing machines will have its first public showing at the National Chemical Exposition, New York City Coliseum, Dec. 2 to 6, at Booths 1371-1373. Manufactured by the Exact Weight Scale Co., Columbus, Ohio, this equipment is capable of proving weight accuracies in the range of one part in 5,000 up to one part in 20,000.

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Two new imitation fruit flavors, strawberry and raspberry, have been developed by Fries & Fries, Inc. Write to Director, Food Research Laboratories, Fries & Fries, Inc., 110 E. 70th St., Cincinnati, Ohio, for information on their practical application.

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The M & H grain tempering machine was designed to give the miller uniform tempering of his mill mix in approximately 2 hours. Rolling cylinders bring each wheat berry into contact with steam and water, holding until the desired moisture content and temperature are reached. When discharged, wheat is homogeneously tempered and ready for the rest bin. Precision instruments control moisture content to within 0.1 of 1%. A folder describes this and the M & H cooling tower. Mid States Mill Equipment Co., 1710 North Mosley, Wichita, Kans.

• • •

Vinyl coating protects elevator buckets with a smooth, durable surface that helps make buckets self-cleaning, protects against rust, and has high abrasion resistance, promoting bucket life and reducing maintenance. Bauer Bros. Co., Springfield, Ohio.

A laboratory gland announced by Arthur F. Smith Co. of Rochester, N. Y., is claimed to offer several advantages over mercury-sealed or precision-bore stirrers. The construction features inner and outer "O" ring seals and a special inner seal ring; no special shafts or tubing required when in use. The gland operates at temperatures as high as 200° C. and is described as nonbreakable, noncontaminating, and completely inert chemically (except with metallic sodium). Available in one size, 24/40 standard taper, with shafts of 6 mm. or 10 mm., and can be fitted with glass adapters for use in wider joints.

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Instruments Cases, Inc., has announced a new, standard line of drawn aluminum instrument cases. The cases comply with specifications MIL-T-945A and MIL-STD-108c, and are available in transit, combination and instrument case types and a wide variety of sizes.

A descriptive booklet will be sent, upon request to Instrument Cases, Inc., 510 Garfield St., Glendale 4, Calif.

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The Temco Stir-Plate, a magnetic stirring hot plate (Thermo Electric Mfg. Co., Dubuque, Iowa), stirs and heats simultaneously or does either operation alone. The unit is well ventilated and insulated. For stirring, a motor-driven magnet rotates beneath the 7 by 7-in. top (heating) plate and exerts a whirling force on the stirring magnet placed in the liquid. Stirring speed is variable. For heating, a sensitive Temco thermostat provides close, stepless control over the entire range to 700°F. (371°C.). The heating element is made of coiled nickel-chromium wire embedded in a refractory plate, which fits into a cavity in the top plate and can be replaced by the user. Additional information will be furnished by the manufacturer: 465 Huff St., Dubuque, Iowa.

. . . Patter

Methods of determining moisture have been summarized in a recent pamphlet published by Central Scientific Company. The 19-page booklet includes a bibliography, an abstract of methods, and lists of suggested apparatus for use with each procedure outlined.

For a copy of Pamphlet 2021, "A Summary of Methods and Suggested List of Equipment for the Determination of Moisture," write to W. L. Long, Central Scientific Company, 1700 Irving Park Road, Chicago 13, Ill.

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Four-year college scholarships for Corn Products Refining Company employees and their children have been established by the Whitehall Foundation, Inc. The scholarships, applicable at any accredited college or university, will be known as the George M. Moffett Scholarships in honor of a past president of Corn Products.

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A. E. Staley Manufacturing Co. is now being represented by Welch, Holme and Clark Co., Inc., of New York, on their Edible Safflower Oil in the New York area.

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More than 35 odorous substances, including hydrogen sulfide, contribute to delicate strawberry flavor, according to Dr. Max J. Winter, of Firmenich, Inc., Switzerland. Dr. Winter spoke to over 200 scientists and directors of research in the food industry who attended the recent flavor symposium held in Chicago and sponsored by Arthur D. Little, Inc., industrial research consultants. Other flavor-research experts discussed what chemicals make up the flavor of citrus fruits, milk, and cheese.

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The donation of $100,000 in research grants to aid Midwest barley farmers has been announced by the United States Brewers Foundation. The funds will be distributed mainly to Midwest colleges, among them the North Dakota Agricultural College at Fargo and the Institute of Agriculture of the University of Minnesota at St. Paul. Breeding superior varieties of barley acceptable to the malting and brewing industries and increasing barley production are two of the research aims supported by the grants.

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Pinto bean plants were inoculated with tobacco mosaic virus and some were then dipped into solutions containing rice extracts. In most cases the treated plants grew and remained healthy, while untreated plants died or were severely damaged.

Several different parts of several rice varieties were used, notably rice "juice" from crushed leaves, and rice "polish," the by-product remaining after kernels are milled. The polish, in general, proved the most effective of all the extracts, whether applied before or immediately after the virus. Results of experiments with different bean varieties and different viruses were uniformly good. In several cases, 100% inhibition was noted.

Significant implications can be attached to the discovery:

1. Rice polish, in effect, amounts to an "immunizing" or chemotherapeutic substance for prevention of several types of virus diseases of beans under greenhouse conditions. In this sense it is, perhaps, comparable to some drugs which prevent diseases in humans and animals.

2. Rice polish, or other rice plant derivatives, may offer a practical means of wide-scale treatment of plants against viral diseases. The polish is already produced in large quantities.

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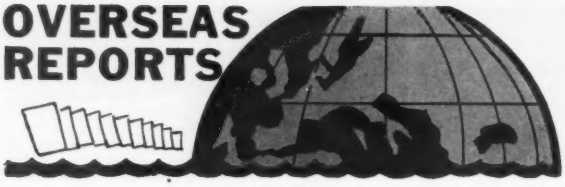
An announcement from London reads in part as follows: "Pergamon Institute, a nonprofitmaking foundation, has recently been formed in New York, and is in course of formation in London, for the purpose of making available to English-speaking scientists, doctors, and engineers from all countries that are members of the United Nations, the results of scientific, technological, and medical research and development in the Soviet Union and other countries in the Soviet orbit. . . . Over a hundred scientists of international standing from many countries have given their support and will supervise the affairs of the Institute."

Encouragement of the teaching of Russian as an important modern language is suggested as the first thing to be done. "There must be at least a thousand current Russian scientific and technical periodicals . . . over 14,000 scientific and technical books were published in Russian in 1954 . . ." but other countries are receiving only a fraction of this literature, and even abstracting service is uneven and inadequate.

The Institute needs support for the work and is seeking, first, people qualified to become members of its panel of paid translators. Suggestions and recommendations will be welcomed. London office is at 4–5, Fitzroy Square, London, W. 1. The Director is Capt. I. R. Maxwell, M.C.



Australia

The 7th Annual Conference of the Cereal Chemistry Group of the Royal Australian Chemistry Institute was held at Tamworth, N.S.W., October 1-4. From the American point of view this group is extremely small consisting of approximately 80 members. However, some of the members live as far apart as 3,000 rail miles, thus the once a year meeting. The following are titles of papers presented this year: "The Surface Chemistry of Proteins" by A. E. Alexander, the University of Sidney; "Surface Chemical Studies of Wheat Gluten" by N. W. Tschoegl, the Bread Research Institute, Sidney; a symposium on "Wheat Classification and Premium Wheats" by J. R. Fisher, N.S.W. Department of Agriculture, L. H. Bird, Agricultural Research Institute, Wagga, N.S.W., and A. J. Meers, N. B. Love, Pty. Ltd., Enfield, N.S.W.; "The Requirements in Ceylon for Australian Flour" by E. J. O'Brien, Victoria State Laboratories, Melbourne; "Carbohydrate Digestion in Livestock, Especially in Relation to High Energy Diets" by G. L. McClymont, University of New England, Armidale, N.S.W.; "Irradiation of Wheat" by I. M. Norris, William Arnott, Pty. Ltd. and F. H. Reuter, N.S.W. University of Technology, Sidney; "Twenty-one Years of Cereal Science" by R. A. Bottomley, Mauri Brothers & Thomson, Ltd., Sidney; "Starch Derivatives" by G. K. Adkins, Wheat Industries (Australian) Pty. Ltd., Tamworth, N.S.W.

R. A. BOTTOMLEY
Corresponding Editor

A.A.C.C.

LOCAL SECTIONS

Nebraska Section No. 4 met on September 28th at the Castle Hotel, Omaha. At the morning session R. M. Sandstedt, University of Nebraska, spoke on further studies in starch granule structure. Mr. Sandstedt's conclusion was that results obtained in flour testing by a single method are sometimes inconclusive and misleading. In the afternoon a panel was held on the quality of the current wheat crop and the problems encountered in milling and baking.

W. W. Cochran, Wallace & Tiernan, Inc., was welcomed as a new member.

The November meeting was on the 9th at the College of Agriculture, Lincoln. The speakers were L. E. Jackson, Victor Chemical Co., and W. Bradshaw, National Carbon and Carbide Co.

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The Midwest Section held its November 4th meeting at the Builders Club, and Dr. Avery Dunn, Sales Manager of Atlantic Gelatin, Division of General Foods Corporation, spoke on "Gelatin, Its Manufacture, Properties, and Application in Foods."

New members are: L. A. Mackenroth, Comco Co.; Harold Rich, Arthur D. Little Co.; Gordon Parker, Quaker Oats Co.; and Al Alton, Wright, Wagner Dairy. Robert B. Koch is now Chief of the Chemistry and Microbiology Branch, Quartermaster Food & Container Institute, and Charles S. McWilliams is now with the American Institute of Baking.

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Chesapeake Section heard a very interesting talk on "The Use of Fats in the Baking Industry" by Ralph B. Morris, Fleischmann Division, Standard Brands, Inc., at their September 26th meeting at Marty's Park Plaza, Baltimore. On October 31st Dr. William B. Bradley, Scientific Director, American Institute of Baking, and president, A.A.C.C., spoke on "The Place of Nutrient Additives in Balanced Bakery Products," at the Log Lodge, Agricultural Research Center, Beltsville, Maryland.

The next meeting will be held on November 28th at Marty's Park Plaza, Baltimore, at 6:30. C. C. Fifield, Sr., Baking Technologist, U.S.D.A., will speak on "Cereal Experiences in India."

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The Pioneer, Nebraska, and Kansas City Sections met in Manhattan, Kansas, on October 11th and 12th for their 28th annual meeting. President William B. Bradley and president-elect Clinton L. Brooke attended and took part in the program.

Dr. Max Thornton, Midwest Research Institute, Kansas City, spoke on the awakening of industry to the possibility of research in their businesses. Dr. Basil Curnutte, Physics Department, Kansas State College, discussed the correlation of infra-red absorption patterns of wheat gluten. Stephen J. Loska, Pillsbury Mills, Inc., stated that present physical dough-testing procedure gives an incomplete picture of dough properties, and that no machine has been designed to measure the stickiness factor, although present knowledge of the rheological dough properties should permit the invention. Professor R. M. Sandstedt, University of Nebraska, demonstrated that overoxidation can be readily overcome by remixing of a dough. Dr. William B. Bradley stated that, while it is possible to demonstrate that bread can be improved nutritionally by extensive rat-feeding tests, man's requirements for certain essential amino acids are different from those required by rats.

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Canadian Prairie Section, Number 14, met in Room 138, Grain Exchange Building, Winnipeg, on Tuesday, October 15. "Research on Malting Barley in Europe" was the subject of a talk by Dr. W.O.S. Meredith, Grain Research Laboratory, Winnipeg.

T. R. Aitken was elected secretary-treasurer to replace S. Kuhl, who is leaving for the North Dakota State Mill, Grand Forks. New members are: M. G. Madden, Brewing and Malting Barley Research Institute, Winnipeg; J. Kassenaar, Dominion Malting Co., Winnipeg; Miss M. E. McMullan, Grain Research Laboratory; and R. Matsuo, Grain Research Laboratory, Winnipeg.

S. N. Jones, president, Winnipeg Grain Exchange, will be the speaker at the November 19th meeting in the Board Room, Grain Exchange Building, Winnipeg.

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Southern California Section, Number 16, met on October 7 at Rodger Young Auditorium, Los Angeles. Dr. Underkofler, Director of Research, Takamine Laboratory,

Clifton, N. J., spoke on "Microbiological Enzymes." His talk was illustrated by slides showing the manufacture of the enzymes in the laboratory as well as in the plant.

Chairman Daniel G. McPherson of General Mills announced his transfer to the San Francisco area. New officers are: chairman, Arnie Koski, Pillsbury Mills; vice-chairman, Cora Miller, U.C.L.A.; secretary, Joe Topps, California Milling; treasurer, to be elected.

Richard M. Henley, California Milling Corporation, is a new member.

The November meeting will be held on the 12th at Rodger Young Auditorium. Dr. Thomas J. Schoch of Corn Products Sales Co. will be the guest speaker.

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The first fall meeting of the New York section was at the Brass Rail Restaurant, 521 Fifth Ave., on October 8. Chairman Donald B. Davis of Continental Baking Co. introduced the section officers for the coming year. They are: vice-chairman, Otto G. Jensen, Nabisco; secretary-treasurer, E. C. Edelman, A&P Tea Co.; program committee, W. J. Simcox, D.P.I., chairman, J. K. Krum, Sterwin Chemicals, J. F. Mahoney, Merck, and Fred C. Ward, National Dairy Research; properties, John N. Curtin, Continental Baking; publicity, R. A. Morck, Nabisco; reception, John T. Buckheit, Standard Brands.

Approximately 85 members and guests were present to hear Dr. W. H. Gellrich, Alpine-Lukens Corporation, give a talk on grinding and classification of flour. His talk was illustrated with slides of both the Alpine Kolloplex "Pin" Mill and the Alpine Mikroplex Spiral Air Classifier.

New local members are: S. Hoffman, The Glidden Co.; D. J. Maveety, Short Hills, N. J.; N. Potter, Fleischmann Laboratories, Stamford, Conn.; David Schwartz, Doughnut Corporation of America, New York; C. W. Brabender, Brabender Instruments, Inc., South Hackensack, N. J.; J. M. Nouss, Anheuser-Busch, Inc., New York; Frank Tanzel, Buitoni Foods, South Hackensack, N. J. Two members have new positions; Earl Spotts is now associated with Continental Baking Co. in their new headquarters in Rye, N. Y., and Paul Snell is now with The Baker Process Co. division, Wallace and Tiernan, Belleville, N. J.

A moment of silence was observed in memory of Herman Giesecke, Anheuser-Busch, Inc., who passed away this summer while visiting abroad.

Dr. C. I. Wrenshall, Director of Technical Service, Chas. Pfizer & Co., Inc., will speak on "Nutritional Plus Values for Cereal Products" at the November 12th meeting at the Brass Rail Restaurant.

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Mr. Weston Inglis, Sales Manager, Gravem-Inglis Baking Co. of Stockton, was the speaker at the October 16th meeting of the Northern California section, which was held jointly with Northern California Bakers' Production Club. Mr. Inglis spoke on "Continuous Bread Making," and also presented a film showing the details of the processing of their white bread production through the J. Baker Do-Maker. This had previously been shown on a "success story" television program.

Toronto Section No. 11 on September 23rd heard Jack Duncan, Head Brew Master, the O'Keefe Ale Brewery, give a very interesting talk on the "History of the Brewing Process," in which he traced the brewing process from Biblical to modern times.

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New members are: H. A. Bowler, Electric Reduction Co., Ltd.; S. Lewis, Maple Leaf Milling Co., Ltd.; and Jo Baird, Canada Packers, Ltd. Tom Snowden, formerly of Canada Packers, Ltd., has joined the staff of Monarch Creamery Products, Ltd., as chief chemist, and is in charge of Bakers Margarine and Shortening.

The November 2nd meeting was held at the Markeen Hotel, Buffalo, N. Y., and was a joint meeting with Section No. 6 and A.O.M. District No. 8. Toronto Section members who planned this meeting are: C. G. Webster, chairman; T. P. Snowden, vice-chairman; G. W. Smiley, secretary; and H. A. Keeping, treasurer.

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Meeting on October 14th in Buffalo, N. Y., Niagara Frontier Section heard Lyle C. Lertz, General Mills, and president of A.O.M., speak on new developments in the milling industry. He also showed pictures of wheat going through an old stone mill, pictures of bread and cake produced from flour from this mill and compared the results with modern-milled flour products. This clearly showed the advances the industry has made in producing a quality flour.

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BOOK reviews

The Chemical Formulary, ed. by H. Bennett; Vol. X, 392 pp. Chemical Pub. Co., Inc., New York, 1957. Price $8.00. Reviewed by P. E. RAMSTAD, General Mills, Inc., Minneapolis, Minn.

Perhaps every chemist has had the experience of losing some of the status accorded him by nontechnically educated friends because he was found not to know how to make a better cold cream than can be bought, or an anti-rust compound that is cheaper and better than any on the market. This volume is the latest in a series that attempt to provide formulas for making almost every kind of chemical specialty, from exotic perfumes and plastic molding compounds to pies, bread, and cakes.

It is frequently useful to be able to find out what sort of ingredients are used in certain products or to gain some idea of the variety of end uses for basic ingredients, or to find out who manufactures a particular type of chemical. This book may provide assistance in doing any one of these. It may also enable one to satisfy a hidden desire to make his own silicone auto polish or brushless shaving cream.

The editor-in-chief and his board of editors have sought to do something that has become increasingly difficult as the chemical field has grown, the number of ingredients used has multiplied, and performance requirements have become more demanding. Many of the formulas call for ingredients that should only be handled by persons having an understanding of toxicological or other hazards involved and how to avoid them. Such information is frequently not given.

The chapter on Food Products does not contain much material likely to be of real value to food chemists. Information given is not sufficiently complete, in this reviewer's opinion, for use by persons inexperienced in this field. Some ingredients identified only by trade names are not included in the list of products and their sellers.

The value of the book would be enhanced by naming the sources of the formulas given, and, where patent numbers are listed, giving the date of issue and the company to whom they are assigned. The reader might also appreciate having each formula checked by one or more experts on the board of editors.

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Methods of Biochemical Analysis, ed. by D. Glick; Vol. 4, 362 pp. Interscience Publishers, Inc., New York, 1957. Price, $8.50. Reviewed by H. S. OLCOTT, Berkeley, Calif.

Laboratory work requires reliable methods. Those who have analytical jobs to do but no time for the patient labor required to develop methods are extremely grateful to the analysts who provide them. Possibly even more helpful are expert compilations of methods such as are made available in this volume. The chapters are in the form of reviews, each covering a specific subject, and are written by experts in their respective fields.

The separate topics are discussed in terms of theory, the various approaches and details of the favored techniques. Laboratory directions are sufficient so that in many cases the book may be used as a laboratory manual without referring to the original papers. However the references to the original papers are provided and are complete.

The titles and authors of the chapters are as follows: "Determination of Carotene" by Bickoff; "Determination of Vitamin A" by Embree *et al.*; "Measurement of Polyunsaturated Fatty Acids" by Holman; "Determination of 17.21-Dihydroxy-20-ketosteroids in Urine and Plasma" by Silber and Porter; "pH-Stat and Its Use" by Jacobsen *et al.*; "Assay of the Sulfatases" by Dodgson and Spenser; "Determination of Serum Acid Phosphatases" by Fishman and Davidson; "Amino Acid Decarboxylases" by Gale; and "Determination of Succinic Dehydrogenase Activity" by Singer and Kearney.

Cereal chemists will probably find the chapters on carotene and vitamin A most immediately useful, but they may soon be called upon to be interested in the measurement of polyunsaturated fatty acids. The elegant quantitative methods for determining amino acids by decarboxylase systems are unfortunately confined as yet to lysine, arginine, histidine, ornithine, tyrosine, and glutamic and aspartic acids. The pH-Stat is a research instrument, developed in Denmark, which is used to follow enzymatic and other reactions at constant pH. As an example, the hydrolysis of an ester is measured continuously in terms of the amount of alkaline solution needed to hold the pH at a constant value. Both titration and recording are automatic.

Author and subject indexes are included, as are also cumulative author and subject indexes for the four volumes. The latter refer only to the authors of and subject matter of the reviews.

The book is an excellent reference manual and laboratory aid for those who now use or contemplate using the methods reviewed. It is handy in size, legible, and remarkably free from minor errors.

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Advances in Enzymology and Related Subjects of Biochemistry, ed. by F. F. Nord; Vol. 18, 435 pp. Interscience Publishers, Inc. New York, 1957. Price, $9.00. Reviewed by WALTER L. NELSON, Cornell University.

Seven of the nine chapters which make up Volume 18 of *Advances in Enzymology* deal with various aspects

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Constant testing is directed toward developing and improving specialized shortenings and oils for the entire field of baking applications.

Temperature durability is a key factor in performance characteristics of shortenings and oils used in frying.

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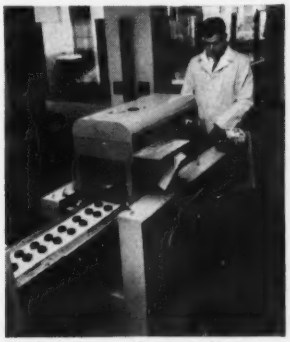

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of energy metabolism involving either the cytochromes, dehydrogenases, cofactors, or intermediates of carbohydrate metabolism. This edition is especially directed toward plant and microbial considerations of some of these important biochemical subjects.

The excellent chapter by E. F. Hartree on "Cytochrome in Higher Plants" and the chapter by W. O. James on "Reaction Paths in the Respiration of the Higher Plants" are highly complementary. Hartree offers the reader a clearly presented interpretation of the cytochromes in plant materials including the nature and properties of the cytochrome components, distribution of cytochrome components in plants, detection and estimation of cytochrome oxidase, cytochromes as terminal oxidases in plant respiration, and cytochrome and photosynthesis. One needs only some basic understanding of the "respiratory chain" in order to benefit maximally from this highly informative chapter. W. O. James' chapter is equally informative and covers the carbon path, electron transfer, and phosphate transfer as applied to the respiration of the higher plants.

"Newer Knowledge of Succinic Dehydrogenase" by Thomas P. Singer, Edna B. Kearney, and Vincent Massey requires of the reader a more highly specialized knowledge of the numerous factors involved in the interpretation of data obtained by other workers in this area than is needed when evaluating the discussions covered by the several other contributors to this volume. The chapter is a lively but sometimes overwhelming presentation of the numerous experiments and interpretations of Singer's soluble purified succinic dehydrogenase versus other preparations having succinic dehydrogenase activity.

"Mechanism of the Toxicity of the Active Constituent of *Dichapetalum cymosum* and Related Compounds" by Rudolph A. Peters offers the reader a clearly presented discussion of the biochemical effects of fluoroacetate and related fluro-carbon compounds. These are discussed under the following headings: chemistry, general toxicity of CF compounds, biochemistry of fluoroacetate and mode of action, use of fluoroacetate as indicator of the tricarboxylic acid cycle, long-chain fluoro fatty acids, protection against fluoroacetate and other fluoro fatty acids and fluorocitric acid *in vivo*, another CF compound in nature, interrelationships with ketone and glucose metabolism, citric acid and the convulsive state, and some other CF compounds.

A survey of the reactions catalyzed by pyrophosphorylases and phosphorylases in biosynthetic reactions by Kornberg and the chemistry and function of lipoic acid by Reed gives valuable insight into these two areas of biochemistry. Both chapters are well written and clearly illustrated with type reactions.

Butler and Davidson present an authoritative discussion on deoxyribonucleoprotein with welcome comments on isolations, composition, and structure; and Wiame discusses the biosynthetic role of the tricarboxylic acid cycle as it applies to microbial systems. Both provide interesting accounts in an area which is undergoing rapid expansion from recent preliminary stages of investigation.

A most welcome chapter for the plant biochemist is Schubert's and Nord's summary of lignification. It is apparent that this field lies in the area of the "related subjects of biochemistry" and so far has either been neglected or has resisted approach by the enzymologist. The authors' introduction states: "the problem of the biogenesis of lignin is this: by what enzymic pathway is this aromatic compound of high degree of polymerization formed from substances pre-existing in the plants?" No precise answers can be given, but some intriguing possibilities are presented.

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Technique of Organic Chemistry, Vol. X, ed. by Arnold Weissberger; **Fundamentals of Chromatography** by Harold Gomes Cassidy; 465 pp. Interscience Publishers Inc., New York, 1957. Price $9.75. Reviewed by J. ROBERT COFFMAN, General Mills, Inc., Minneapolis, Minn.

This book discusses chromatography from the standpoint of principle. It is designed to give an understanding of the fundamentals involved in the chromatographic processes, and to answer questions concerning *how* and *why* chromatography operates. To do this, theoretical considerations are clearly explained and related to practical applications of chromatography.

The text is well organized according to the following plan: In Chapters I and II various definitions are presented. Chapter III defines molecular phenomena as a basis for chromatographic separation. Chapter IV presents the general theory by which chromatography may be explained. Chapters V through XI describe the various chromatographic processes such as gas-liquid, paper, column, absorption, ion exchange, electron exchange, and foam-emulsion. Chapter XII discusses methods of zone recognition. Chapter XIII relates R and R to molecular structure. Chapter XIV describes how the mobile and stationary phases may be chosen. Chapter XV describes basic methods for applying chromatography to specific problems which the reader may have.

In the Appendix there is presented a list of the sources of all types of chromatographic equipment and the addresses of the various industrial firms referred to in the text. In addition to this helpful information, the author has included tables throughout the text which show the names, composition, and physical properties of various ion exchange resins and other column packings. This information is most helpful in evaluating the work of others and in choosing equivalent materials for chromatographic work.

The book is to be highly recommended for its value for better understanding and using chromatography as a means of solving various analytical, isolation, and purification problems.

Fertilizer:

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sufficiently high for milling and baking purposes. This makes it unprofitable to fertilize for protein, because in seasons when no yield response is obtained, protein increases are realized from low or moderate amounts of nitrogen, but there is no market for it, while in seasons when yields are high, yields are increased and relatively high amounts of nitrogen are required for protein increases.

Farmers can, then, produce high-protein wheat by applying nitrogen late, but there is no incentive for that when they do not know, until the crop is harvested, whether or not a premium will be paid for high protein. We know how to fertilize for protein but until it is made profitable farmers cannot afford to do it.

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